MEMORANDUM

JACOBS

BD Medical Expansion: Autoguard Manufacturing Lines 12 through 14

PREPARED FOR:	Ana Williams/UDAQ
COPY TO:	Bob Partner/BD Medical
PREPARED BY:	Jared Carling/Jacobs
DATE:	June 21, 2018
PROJECT NUMBER:	684293

Since the submission of the Notice of Intent (NOI) in December 2017 for the updated fire pump engine and addition of two new process lines, Autoguard Line 11 and Nexiva Line 3, BD Medical has made plans to convert warehouse space into manufacturing cleanrooms and add three additional Autoguard catheter manufacturing lines (Autoguard Lines 12 through 14). These proposed production lines will increase the facility's potential volatile organic carbon (VOC) emissions proportional to the increase in production. VOC emissions are primarily from cleaning and disinfecting the new production lines and cleanrooms using isopropyl alcohol. No hazardous air pollutant (HAP) containing materials will be used in the proposed production lines. All process emissions from Autoguard Lines 12 through 14 will be vented to a new regenerative thermal oxidizer with a destruction efficiency of 98 percent.

Emissions Information

Emissions from the new production lines will include the VOC heptane and isopropyl alcohol and combustion byproducts from the regenerative thermal oxidizer (RTO). Emissions from the proposed process steps will be captured and vented to the RTO while emissions from cleaning and disinfecting will exit the general building exhaust. Potential emission estimates are provided in Table 1, with detailed emission calculations provided in Attachment A. The proposed RTO, dubbed the Boxidizer, is manufactured by Alliance Corporation and the specification sheet is provided in Attachment B.

Table 1. Potential to Emit Emissions Summary

Pollutant	Current PTEs From AO DAQE-AN103770009-16	Modification 1: Fire Pump, Autoguard Line 11, and Nexiva Line 3	Modification 2: New Autoguard Lines 12 through 14	Modifications 1 and 2 Total	Proposed PTEs
NO_x emissions (tpy)	18.11	-0.01	0.03	0.02	18.13
CO emissions (tpy)	13.12	0.00	0.05	.05	13.17
PM_{10} emissions (tpy)	1.31	0.00	0.00	0.00	1.31
$PM_{2.5}$ emissions (tpy)	1.31	0.00	0.00	0.00	1.31
SO_2 emissions (tpy)	0.79	0.00	0.00	0.00	0.79
VOC emissions (tpy)	22.43	1.12	1.65	2.77	25.20
HAP emissions (tpy)	2.12	0.00	0.001	.001	2.12

Table 1. Potential to Emit Emissions Summary

Pollutant	Current PTEs From AO DAQE-AN103770009-16	Modification 1: Fire Pump, Autoguard Line 11, and Nexiva Line 3	Modification 2: New Autoguard Lines 12 through 14	Modifications 1 and 2 Total	Proposed PTEs
GHG emissions (tpy CO_2e)	10,027	0.68	87.42	88.00	10,116

Notes:
NO_X = Nitrogen Oxides
SO_2 = Sulfur Dioxide
CO = Carbon Monoxide
VOC = Volatile Organic Compound
HAP = Hazardous Air Pollutant
PM_{10} = particulate matter with aerodynamic diameter of 10 microns or less
$PM_{2.5}$ = particulate matter with aerodynamic diameter of 2.5 microns or less
AO = approval order
GHG = greenhouse gasses
PTE = potential to emit

Control Technology Analysis

The new production lines will result in additional VOC emissions beyond existing conditions. BD Medical proposes to vent all VOC emissions from the new production lines to a new RTO. Per previously submitted best available control technology (BACT) analyses, this oxidizer, coupled with highly efficient capture rates, represent the BACT for controlling VOC emissions from medical device manufacturing. Manufacturer rated destruction efficiency of the oxidizer is at least 98 percent when operating above 1,400˚F. The RTO is equipped with digital monitoring of the combustion chamber temperature. Capture efficiency is regularly monitored using visual smoke tests to ensure optimal capture of emissions from medical device manufacturing processes. Furthermore, the processes will comply with all VOC area source rules recently adopted by the Utah Air Quality Board representing BACT measures within the airshed.

Existing Thermal Oxidizer Operating Temperatures

At the request of Utah Division of Air Quality, BD Medical is providing the manufacturers recommended minimum operating temperature for each of the oxidizers and is working with vendors to upgrade the monitoring equipment to easily comply with any new monitoring and recordkeeping requirements. Information for each oxidizer is summarized in Table 2.

Table 2. BD Medical Thermal Oxidizers

Unit	Minimum Operating Temperature	Monitoring
Lesni Catalytic Oxidizer	140˚C	Equipped with digital monitoring of catalyst bed temperature.
Lesni RTO	700˚C	Has an analogue chart recorder and BD Medical is working with the manufacturer to upgrade the monitoring equipment.
Alliance Thermal Incinerator	1,400°F	Has an analogue chart recorder and BD Medical is working with the manufacturer to upgrade the monitoring equipment.
Alliance Boxidizer	1,400°F	Equipped with digital monitoring of combustion temperature.

The VOC limitation found in Condition II.B.6.a of the AO will increase 2.77 tpy to accommodate the two modifications. These emissions are primarily isopropyl alcohol from cleaning and disinfecting. The new VOC limit for Condition II.B.6.a is proposed as 23.85 tpy. The HAP limit will remain unchanged.

Should you have any questions, please contact Jared Carling at 385-474-8509 or Bob Partner at 801-565-2507.

Attachment A
Emission Calculations

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PTE Emissions Summary

Pollutant	Current PTEs From AO DAQE-AN103770009-16	Revised Fire Pump, Autoguard Line 11 and Nexiva Line 3	New Autogaurd Lines 12 through 14	Proposed PTEs
NOx emissions (tpy)	18.11	-0.01	0.03	18.13
CO emissions (tpy)	13.12	0.00	0.05	13.17
PM_{10} emissions (tpy)	1.31	0.00	0.00	1.31
$PM_{2.5}$ emissions (tpy)	1.31	0.00	0.00	1.31
SO_2 emissions (tpy)	0.79	0.00	0.00	0.79
VOC emissions (tpy)	22.43	1.12	1.65	25.20
HAP emissions (tpy)	2.12	0.00	0.001	2.12
GHG emissions (tpy CO_2e)	10027	0.68	87.42	10116
PM_{10} + SO_2 + NOx (tpy)	20.21	-0.01	0.04	20.23

Notes:

NO_X = Nitrogen Oxides

SO_2 = Sulfur Dioxide

CO = Carbon Monoxide

VOC = Volatile Organic Compound

HAP = Hazardous Air Pollutant

PM10 = particulate matter with

PM2.5 = particulate matter with aerodynamic diameter of 2.5 microns or less

AO = approval order

GHG = greenhouse gasses

PTE = potential to emit

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Autogaurd Thermal Oxidizer Emissions Calculations[1]

	T.O.	Source
NOx Emission Factor (lb/10^{o}scf)	50	[AP-42, Table 1.4-1, Small Boilers < 100 MMBTU/hr, controlled (low NOx burner)]
CO Emission Factor (lb/10^{o}scf)	84	[AP-42, Table 1.4-1, Small Boilers < 100 MMBTU/hr, controlled (low NOx burner)]
PM_{10} Total Emission Factor (lb/10^{b}scf)	7.6	[AP-42, Table 1.4-2]
SO_2 Emission Factor (lb/10^{b}scf)	0.6	[AP-42, Table 1.4-2]
VOC from incomplete combustion (lb/10^{o}scf)	5.5	[AP-42, Table 1.4-2]
Max process VOC mass loading rate (lb/hr)	0.92	Manufacturer Specs

	T.O.	Source
Heat Input for TO (MMBTU/hr)	0.15	BOXIDIZER spec sheet
Natural Gas Heating Value (BTU/scf)	1026.00	40 CFR 98.33 Table C-1
Natural Gas Usage (scf/hr)	144.43	
Natural Gas Usage (10^{o}scf/hr)	0.0001	
Annual Hours of Operations (hrs/yr)[2]	8,664	
VOC destruction efficiency (%)	98	BOXIDIZER spec sheet
NO_X Emissions (lb/hr)	0.01	
CO Emissions (lb/hr)	0.01	
PM_{10} Emissions (lb/hr)	0.00	
$PM_{2.5}$ Emissions (lb/hr)	0.00	
SO_2 Emissions (lb/hr)	0.00	
Burner VOC Emissions (lb/hr)	0.00	
Process VOC Emissions (lb/hr)	0.02	
NO_X Emissions (tpy)	0.03	
CO Emissions (tpy)	0.05	
PM_{10} Emissions (tpy)	0.00	
$PM_{2.5}$ Emissions (tpy)	0.00	
SO_2 Emissions (tpy)	0.00	
Burner VOC Emissions (tpy)	0.00	
Process VOC Emissions (tpy)	0.08	

NOTES:

[1] The Thermal Oxidizer will use natural gas as a fuel. Therefore, emissions for

[2] Annual hours of operation are 8,760 less 96 hours for bypass or 8,664 hours.

Product	Chemical	CAS#	Chemical wt. % of Product	Amount of Product Consumed Per Year (lb) [1]	Amount of Chemical Consumed Per Year (lb) [1]	Uncontrolled Emissions (ton/year)	Uncontrolled Emissions (lb/hr)	HAP
Isopropyl Alcohol	IPA	67-63-0	100%	3,221	3,221	1.61	0.37	N

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Thermal Oxidizer Bypass Emissions

Product	Chemical	CAS#	Chemical wt. % of Product	Amount of Product Consumed Per Year (lb)[1]	Amount of Chemical Consumed Per Year (lb)[1]	Uncontrolled Emissions (ton/year)	Uncontrolled Emissions (lb/hr)	Annual Hours of Oxidizer Bypass	VOC Bypass Emissions (lb/yr)	HAP	HAP Bypass Emissions (lb/yr)
Heptane	Heptane	31394-54-4	100%	8,059	8,059	4.03	0.92	96.00	88.32	N	0.00
								Total	88.32		0.00

Note:

[1]Usage rates provided by BD Medical

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GHG Emissions from Oxidation Controls

Product	Chemical	Chemical wt. % of Product	Amount of Product Oxidized Per Year (lb)[1]	Amount Chemical Oxidized Per Year (lb)	CAS#	Moles CO_2 Produced per Mole Chemical	Molecular Weight of Chemical (lb-mol)	Molecular Weight CO_2 (lb-mol)	CO_2 Produced (lb)	CO_2 Produced (tpy)	CO_2e Produced (tpy)
Heptane	Heptane	100%	7,971	7,971	31394-54-4	7	100.20	44.01	24,506	12.25	12.25

Notes:

[1]Amount of product oxidized per year provided by BD Medical.

Potential emission estimates above are overly conservative because only the pure heptane calculation accounts for spent material collected for waste removal.

Waste profiles for other waste streams do not provide adequate detail to accurately estimate the reduction of emissions due to waste collection.

Balanced Thermal Oxidation Reaction:
Heptane: $C_7H_{18} + 11O_2 \rightarrow 7CO_2 + 8H_2O$

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Natural Gas Combustion GHG and HAP Emissions

	Autogaurd RTO
Quantity	1
Heat Input (MMBTU/hr)[1]	0.15
Total Heat Input (MMBTU/hr)	0.14819
Natural Gas Heating Value (BTU/scf)	1026.00
Natural Gas Usage (scf/hr)	144
Natural Gas Usage (10^6scf/hr)	0.0001
Annual Hours of Operations (hrs/yr)	8,664
Natural gas usage (MMBTU/yr)	1,284

Note:

[1]Heat Input information provided from manufacturer specifications

HAP Emissions

Pollutant	(lb/10^6scf)[1]	Emissions (lb/hr)	Emissions (lb/yr)	Emissions (tpy)
2-Methylnaphthalene	2.40E-05	3.47E-09	3.00E-05	1.50E-08
3-Methylchloranthene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
7,12-Dimethylbenz(a)anthracene	1.60E-05	2.31E-09	2.00E-05	1.00E-08
Acenaphthene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Acenaphthylene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Anthracene	2.40E-06	3.47E-10	3.00E-06	1.50E-09
Benza(a)anthracene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Benzene	2.10E-03	3.03E-07	2.63E-03	1.31E-06
Benzo(a)pyrene	1.20E-06	1.73E-10	1.50E-06	7.51E-10
Benzo(b)fluoranthene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Benzo(g,h,i)perylene	1.20E-06	1.73E-10	1.50E-06	7.51E-10
Benzo(k)fluoranthene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Chrysene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Dibenzo(a,h)anthracene	1.20E-06	1.73E-10	1.50E-06	7.51E-10
Dichlorobenzene	1.20E-03	1.73E-07	1.50E-03	7.51E-07
Fluoranthene	3.00E-06	4.33E-10	3.75E-06	1.88E-09
Fluorene	2.80E-06	4.04E-10	3.50E-06	1.75E-09
Formaldehyde	7.50E-02	1.08E-05	9.39E-02	4.69E-05
Hexane	1.8	2.60E-04	2.25E+00	1.13E-03
Indeno(1,2,3-cd)pyrene	1.80E-06	2.60E-10	2.25E-06	1.13E-09
Naphthalene	6.10E-04	8.81E-08	7.63E-04	3.82E-07
Phenanathrene	1.70E-05	2.46E-09	2.13E-05	1.06E-08
Pyrene	5.00E-06	7.22E-10	6.26E-06	3.13E-09
Toluene	3.40E-03	4.91E-07	4.25E-03	2.13E-06
		0.00E+00	0.00E+00	
Arsenic	2.00E-04	2.89E-08	2.50E-04	1.25E-07
Beryllium	1.20E-05	1.73E-09	1.50E-05	7.51E-09
Cadmium	1.10E-03	1.59E-07	1.38E-03	6.88E-07
Chromium	1.40E-03	2.02E-07	1.75E-03	8.76E-07
Cobalt	8.40E-05	1.21E-08	1.05E-04	5.26E-08
Manganese	3.80E-04	5.49E-08	4.76E-04	2.38E-07
Mercury	2.60E-04	3.76E-08	3.25E-04	1.63E-07
Nickel	2.10E-03	3.03E-07	2.63E-03	1.31E-06
Selenium	2.40E-05	3.47E-09	3.00E-05	1.50E-08
Lead	5.00E-04	7.22E-08	6.26E-04	3.13E-07
Total			**2.36**	**1.18E-03**
Maximum Individual HAP			2.25E+00	Hexane

NOTE:

[1] HAP Emission Factors from AP-42, Tables 1.4-3 and 1.4-4.

GHG Emissions Calculations

Source	Quantity	Max Heat Input (MMBtu/hr)	Btu/scf conversion	Max Fuel Throughput (scf/hr)	Annual Hours of Operation	Max Annual Fuel Consumption (MMBtu)	Max Annual Fuel Consumption (MMscf)	CO_2 Emissions (tpy)	CH_4 Emissions (tpy)	N_2O Emissions (tpy)	CO_2e Emissions (tpy)
Autogaurd TO	1	0.15	1026	144	8,664	1,284	1	75	0.00	0.00	75

Notes:

CO_2	53.06	kg/MMBtu	40 CFR 98.33 Table C-1
CH_4	0.001	kg/MMBtu	40 CFR 98.33 Table C-2
N_2O	0.0001	kg/MMBtu	40 CFR 98.33 Table C-2
Conversion	1.1023	ton/ tonne	
Emissions are calculated using 40 CFR 98.33 Equation C-1b			
CH_4	25	GWP	40 CFR 98 Table A-1
N_2O	298	GWP	40 CFR 98 Table A-1

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Natural Gas Combustion GHG and HAP Emissions

HAP Summary

Pollutant	Emissions (lb/hr)	Category	ACGIH TLV	Units	MW	Convert to mg/m^3	ETF	ETV	Modeling Required ?	
2-Methylnaphthalene	3.47E-09									
3-Methylchloranthene	2.60E-10									
7,12-Dimethylbenz(a)anthracene	2.31E-09									
Acenaphthene	2.60E-10									
Acenaphthylene	2.60E-10									
Anthracene	3.47E-10									
Benza(a)anthracene	2.60E-10									
Benzene	3.03E-07	A1	0.5	ppm	78.1121	1.59738446	0.066	0.105427374	#NAME?	Used chronic ETF as per UDAQs TLV workbook
Benzo(a)pyrene	1.73E-10									
Benzo(b)fluoranthene	2.60E-10									
Benzo(g,h,I)perylene	1.73E-10									
Benzo(k)fluoranthene	2.60E-10									
Chrysene	2.60E-10									
Dibenzo(a,h)anthracene	1.73E-10									
Dichlorobenzene	1.73E-07	Chronic	10	ppm	147	60.1226994	0.066	3.96809816	N	
Fluoranthene	4.33E-10									
Fluorene	4.04E-10									
Formaldehyde	1.08E-05	cute/Carcinog	0.3	ppm	30.03	0.36846626	0.051	0.018791779	N	
Hexane	2.60E-04	Chronic	50	ppm	86.18	176.237219	0.066	11.63165644	N	
Indeno(1,2,3-cd)pyrene	2.60E-10									
Naphthalene	8.81E-08	Chronic	10	ppm	128.19	52.4294479	0.066	3.460343558	N	
Phenanathrene	2.46E-09									
Pyrene	7.22E-10									
Toluene	4.91E-07									
Arsenic	2.89E-08	A1	0.01	mg/m^3		0.01	0.022	0.00022	N	
Beryllium	1.73E-09	A1	0.00005	mg/m^3		0.00005	0.022	0.0000011	N	
Cadmium	1.59E-07	A2	0.002	mg/m^3		0.002	0.022	0.000044	N	
Chromium	2.02E-07	A1	0.01	mg/m^3		0.01	0.022	0.00022	N	

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Natural Gas Combustion GHG and HAP Emissions

HAP Summary

Pollutant	Emissions (lb/hr)	Category	ACGIH TLV	Units	MW	Convert to mg/m^3	ETF	ETV	Modeling Required ?
Cobalt	1.21E-08	Chronic	0.02	mg/m^4		0.02	0.066	0.00132	N
Manganese	5.49E-08	Chronic	0.2	mg/m^3		0.2	0.066	0.0132	N
Mercury	3.76E-08	Chronic	0.01	mg/m^3		0.01	0.066	0.00066	N
Nickel	3.03E-07								
Selenium	3.47E-09	Chronic	0.2	mg/m^3		0.2	0.066	0.0132	N
Lead	7.22E-08								
Total	**0.0784**								

Notes:

ETFs correspond to a vertically restricted release 20-50 meters from the property boundary.

All xylene emisssions are assumed to be the m-xylene isomer which has the lowest ETV of all xylene isomers.

ACGIH:	American Conference of Governmental Industrial Hygienists
TLV:	Threshold Limit Value
MW:	Molecular Weight
ETF:	Emissions Threshold Factor
ETV:	Emission Threshold Value

Attachment B
Boxidizer Specification Sheet

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December 19, 2017

Mr. Eric Wells
BD Medical
9450 South State Street
Sandy, Utah 84070

Reference: Alliance Corporation Proposal Number 17-2070 R2

Dear Mr. Wells:

Alliance Corporation is pleased to offer this proposal for the supply of a BOXIDIZER™ 2-bed Regenerative Thermal Oxidizer (RTO) system to treat the exhaust from BD Medical's process source.

Design Criteria

Process:	**Case 1:**
Medical Device Manufacturing	1,000 SCFM
Solvent:	
Heptane	0.46 lbs/hr
MEK (Methyl Ethyl Ketone) (2-Butanone)	0.46 lbs/hr
Solvent Load:	0.92 lbs/hr
Heat of Combustion:	17,634 btu/lb
Notes:	
· *Design Destruction Efficiency.*	98 % +
· *Destruction Efficiency Guarantee.*	98 %
· *Nominal Thermal efficiency.*	95 %
· *Effective Thermal efficiency.*	95.5 %
· *Inlet Temperature.*	70 °F.
· *Job Site Elevation*	4,500 ft.

BOXIDIZER™

The BOXIDIZER™ RTO by Alliance Corporation offers the benefits of high heat recovery and process application flexibility of regenerative thermal oxidization, designed in an economical package to create an outstanding overall value in emissions control equipment. The BOXIDIZER™ is designed such that the valves required to direct the flow through the heat exchange media are incorporated into the oxidizer body. This integral valve feature eliminates the transition ducts often associated with conventional RTO designs and minimizes entrained volume to enhance VOC destruction efficiency and minimizes the oxidizer footprint. The entire oxidizer comprises a single compact box on a skid and fits completely within a standard ISO 20' shipping container.

Every BOXIDIZER™ RTO is completely pre-assembled, piped and wired. This pre-assembly reduces the installation effort and maximizes quality control over the finished product. Every BOXIDIZER™ RTO undergoes extensive factory testing, control system check out and calibration prior to shipment to facilitate short start-up time.

Every BOXIDIZER™ RTO features state-of-the-art controls. The local Ethernet connecting the Programmable Logic Controller to Human Machine Interface also is fitted with a Virtual Private Network firewall. This VPN allows Alliance secure encrypted remote access to the control

system to monitor BOXIDIZER™ in real time. The VPN has the effect of putting a virtual Alliance service technician onsite instantly to troubleshoot and diagnose any issues for immediate and extended hour support for maximum uptime. The VPN also allows us to monitor the BOXIDIZER™ long term to detect up any process or operational trends that might develop to ensure that the BOXIDIZER™ is always optimized.

In addition to the performance advantages of the BOXIDIZER™ RTO design there are the added benefits of quality components, craftsmanship and attention to detail by Alliance Corporation. Each BOXIDIZER™ RTO is completely pre-assembled, calibrated and tested. The BOXIDIZER™ RTO ships ready to install and typically our supervision *is not required* for installation. If your firm is capable of unloading the shipping container when it arrives and setting the equipment in place, you will have completed most of the installation. Generally, all that remains is the utilities and ductwork. Of course, Alliance will provide complete turnkey services should BD Medical prefer; however, our goal is to provide equipment completely assembled to simplify the installation and minimize overall project costs.

The following components and features are included in the proposed BOXIDIZER™ Model 203 Regenerative Thermal Oxidizer System:

- ✓ One (1) BOXIDIZER™ regenerative thermal oxidizer which includes:
  - Two (2) internally insulated integral heat exchange beds with structured heat exchange media for 95% nominal thermal efficiency and low pressure drop.
  - Internally insulated integral combustion chamber.
  - One (1) *Maxon 1 1/2" Kinemax* burner with natural gas fuel train and pilot.
  - One (1) *New York Blower* 1404A direct drive combustion air fan with 1.5 HP high efficiency TEFC motor.
  - Digital burner stoichiometric control.
  - Four (4) integral pneumatic poppet valves.
  - Main control cabinet with *Allen Bradley CompactLogix L30ER* control system, *Idec HG2G* 5.7” TFT, 256 color touch screen, Ethernet switch to for remote tie-in and a VPN.
  - One (1) three color stacked beacon status light assembly.
  - 5 HP *Allen Bradley PowerFlex 753* Variable Frequency Drive mounted in main control cabinet.
  - Skid mounted.
  - Completely shop assembled, piped, wired and painted.
- ✓ One (1) *New York Blower* 194 DH 30, 1,764 RPM forced draft process fan with 5 HP high efficiency TEFC motor. This fan is sized to provide -2.0” WC for BD Medical collection ductwork.
- ✓ One (1) inlet manifold with pneumatically actuated process block and fresh air dampers, inlet vacuum transducer and flow sensor.
- ✓ Vibration isolators for process fan inlet and outlet connections, and base mounting.
- ✓ Full 12 month warranty, including all parts and telemetry monitoring.
- ✓ Engineering drawings to assist customer in installation, start-up, and permitting of oxidizer.

Recommended Options

Variable Frequency Drive (VFD)

This option is to precisely control the flow to the needs of the process to optimize operating costs. This option consists of an *Allen-Bradley PowerFlex 753* Variable Frequency Drive, an inlet static pressure transducer, up-sizing the standard control cabinet and adding an air conditioner to the control cabinet to dissipate the heat generated by the VFD.

Chart Recorder

This option is to provide a six pen Honeywell eZTrend GR digital recorder to log the combustion chamber temperature, process flow, and fuel flow. The PLC will be fitted with an additional 4-20 mA analogue output module to repeat the process variable signals to the chart recorder. The chart recorder will be protected from the surrounding environment by a NEMA 4 viewing cover.

Controls Winterization

This option is to avoid freezing in the control cabinet and process sample lines. The following items will be integrated into the controls:

- One 300/600 watt PTC type panel heater with integral fan for the main control cabinet.
- Adjustable thermostat.
- Six rotometers to purge critical process sample lines from the instrument back to the source, with -22°F. dew point compressed air or nitrogen.

Remote Operator Interface

This option is to provide a secondary Idec operator interface to tie into the local KRONUS™ Ethernet to remotely duplicate the enunciation and monitoring of the primary Idec on KRONUS™ main control cabinet. This option consists of an Idec HG2G 5.7" TFT, 256 color touch screen operator interface mounted on the door of a 12" x 12" x 5" enclosure containing a 24 VDC power supply. Mounting of the enclosure, 120 VAC power, and CAT 5 Ethernet cable from Idec to the Ethernet switch in the KRONUS™ main control cabinet by others.

Duplex Process Fans

This option is to duplicate the *New York Blower 194 DH 30*, 5 HP process fan, 5 HP *Allen-Bradley PowerFlex 753* Variable Frequency Drive, along with adding automated isolation dampers, and manifold modification to integrate the redundant fan with the primary process fan to create a duplex system. The pair of process fans will normally operate in parallel unison, each at half flow, however, each fan will have the capacity to step up and convey the full flow if needed.

Exhaust Stack

This option is 16" diameter by 15' tall ground mounted stack. The will be designed following SMACNA guidelines. The stack will be fitted with two (2) 2" diameter 90° opposed sampling ports and a breach for field connection to the BOXIDIZER™ exhaust nozzle.

Start-up & Training Alliance Corporation will startup and commission the BOXIDIZER™ system described herein. Assuming installation is complete and that all utilities are operational, we estimate that the start-up will require 2 days on-site. The start-up will include any programming changes necessary to interface the BOXIDIZER™ system with the process. After all parties are satisfied with the operation, we will conduct the training. The training will include a classroom session to describe the system and discuss the theory of operation, operation practice, maintenance, health and safety in detail followed by a question answer session. From the classroom, our engineer will take the group to the equipment and identify all components and answer any further questions.

Operating Costs

The ***estimated*** operating conditions for the proposed unit are as follows:

	Case 1:	Ready:
	1,000 scfm	**864 scfm**
Fuel Variables:		
Inlet temperature	70 °F.	70 °F.
Process contribution	16,223 btu/hr	0 btu/hr
Supplemental burner fuel	131,967 btu/hr	97,576 btu/hr
Pilot fuel	0 btu/hr	0 btu/hr
Average stack temperature	138 °F.	106 °F.
Total natural gas required	1.32 therms	0.98 therms
Fuel operating cost @ $0.500/therm	$0.66 hour	$0.49 hour
Electricity Variables:		
Oxidizer pressure drop	2.6 "wc	2.1 "wc
Process fan (with -2"WC upstream) *	1.5 bhp	1.2 bhp
Combustion air fan	0.6 bhp	0.6 bhp
Controls	375 watts	375 watts
Total electricity required	2.0 kWH	1.7 kWH
Electricity operating cost @ $0.090/kWH	$0.18 hour	$0.16 hour
Total utility operating cost	**$0.84 hour**	**$0.65 hour**

* Based on VFD

The above fuel consumption values include burner efficiency and thermal radiation. As process solvents increase, natural gas consumption declines. Ready Mode is defined as the oxidizer operating at 1600° F. and approximately 25% flow while waiting for an input signal from the process to advance to Run Mode. During Idle Mode the burner and process fan are simply turned off and the oxidizer is allowed to slowly cool. The rate at which the BOXIDIZER™ cools is so slow that very little heat is lost during Idle Mode. For example, warm up time after idling overnight is typically less than an hour and less than three hours after idling over a weekend.

Requirements

Electrical service to oxidizer panel:	480 volt, 3 phase, 60 hertz, 5 kVA service
Fuel:	200 SCFH of natural gas @ 1.5 psig
Compressed air:	8 SCFH of clean, dry compressed air @ 80 psig
Oxidizer footprint:	18'-9" x 7'-6"
Approximate weight:	22,400 pounds
Communication:	DHCP line with internet access

Note: The electricity and fuel quantities above include adequate margin to ensure operation for the most extreme conditions and are not representative of the expected actual consumption, which is considerably less. The dimensions are for the oxidizer skid perimeter only and do not include, access ways, or peripherals.

Pricing

One (1) BOXIDIZER™ 203 Regenerative Thermal Oxidizer System as described herein:	**$113,685**
Option: 5 HP VFD SYSTEM	**$3,145**
Option: 3 PEN CHART RECORDER	**$3,566**
Option: CONTROLS WINTERIZATION	**$1,501**
Option: REMOTE OPERATOR INTERFACE	**$1,504**
Option: DUPLEX PROCESS FANS	**$16,394**
Option: EXHAUST STACK	**$4,616**
Option: START-UP	**$5,135**
TOTAL	**$149,546**

The above prices are F.O.B. La Habra, California and exclude installation, and taxes. Prices are valid for sixty (60) days.

Delivery

This oxidizer system can be manufactured and ready for shipment in approximately 14-18 weeks from receipt of a purchase order and down payment. If a shorter time period is required, please contact us to discuss accelerating the schedule.

Terms

30% due with purchase order
30% due 60 days prior to scheduled shipment, invoiced at drawing submittal
30% due 10 days prior to shipment, invoiced 40 days prior to shipment
10% 30 days after shipment, invoiced at shipment

Should you have any additional questions or comments after your review of this proposal, please contact us. Thank you.

Sincerely,

Alliance Corporation

William L. Thompson

calculations prepared with kronus-s5.xlw, rev 1.4

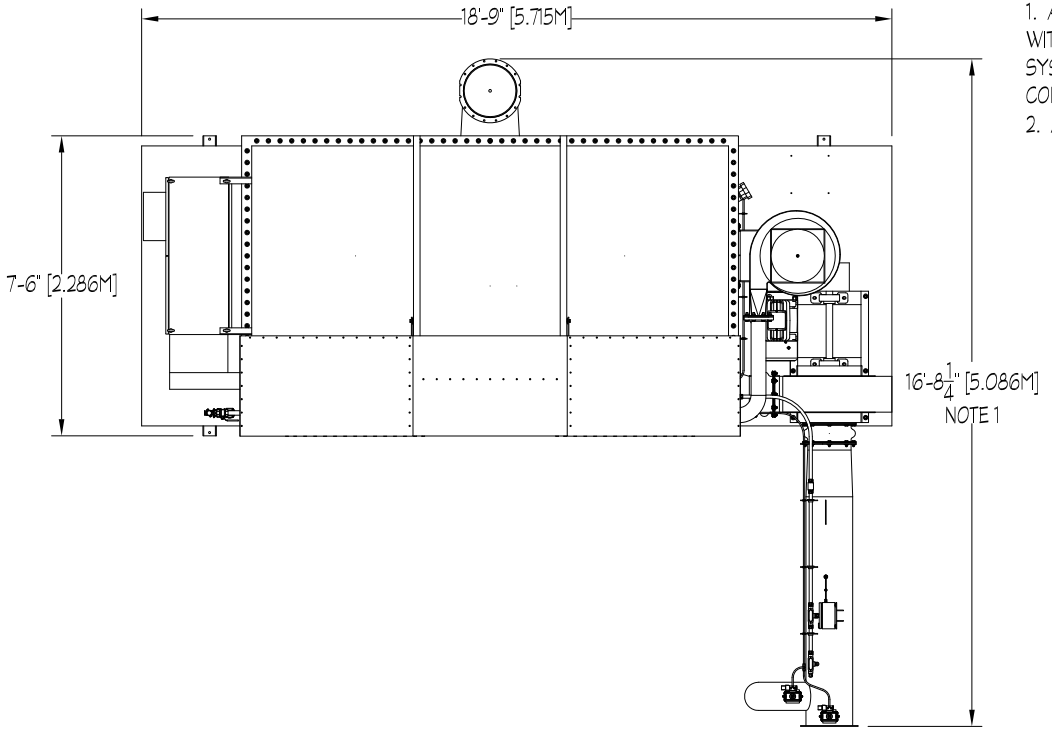
BOXIDIZER™

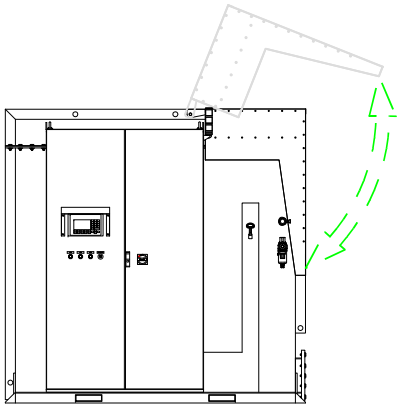
Introducing the BOXIDIZER™ by Alliance Corporation, a new economical RTO system that achieves a new level of transport simplicity for domestic and export markets. The BOXIDIZER™ RTO builds the proven elements of our successful KRONUS™ RTO family, designed to completely fit within a 20' standard ISO shipping container.

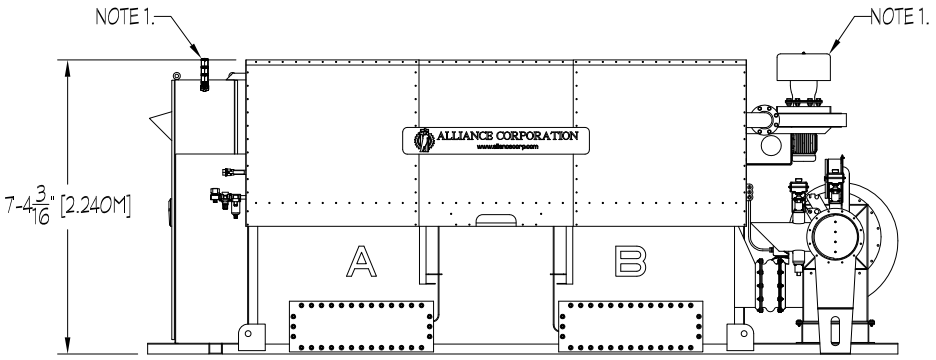
Standard features:

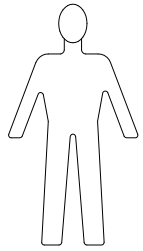
- ✓ Completely pre-assembled
- ✓ Completely pre-piped
- ✓ Completely pre-wired
- ✓ Easy installation
- ✓ ¼" Carbon steel housing
- ✓ 8" Compressed SuperWool® ceramic fiber insulation
- ✓ Structured heat exchange media
- ✓ Chemically etched, 2 part epoxy primed and urethane finish coated
- ✓ Air cooled site glass
- ✓ Machined billet steel poppet valve seats
- ✓ Solid stainless steel poppet shafts with purged housings
- ✓ Maintenance free shaft guide bearings
- ✓ Pneumatic poppet actuators with internal cushions and dual alignment couplers
- ✓ Machined billet steel poppet disk hubs & caps
- ✓ Instrument air header/reservoir with regulator
- ✓ Process fan installed complete with vibration isolators
- ✓ Variable frequency drive
- ✓ Circuit breakers throughout, no fuses
- ✓ Full instrumentation includes; process vacuum, process flow, RTO differential pressure, fuel gas flow and combustion air flow sensors in addition to pressure switches and thermocouples for precise control
- ✓ Automatic analog sensor calibration
- ✓ Digital air/gas ratio and throttle control
- ✓ VPN
- ✓ Text/email messaging
- ✓ Graphic operator interface
- ✓ Stacked beacon lights
- ✓ 7-Day programmable automatic start/stop timer
- ✓ Automated component weather cover
- ✓ Lifetime software warranty
- ✓ Full factory testing includes burner firing

NOTES:
1. APPENDAGES ARE REMOVED AND MOUNTED WITHIN OXIDIZER PROFILE FOR SHIPPING. ENTIRE SYSTEM FITS WITHIN A 20' STANDARD ISO SHIPPING CONTAINER.
2. APPROXIMATE WEIGHT 22,400 LBS [10,160 kG].









ALLIANCE CORPORATION

BOXIDIZER 203 REGENERATIVE THERMAL OXIDIZER BASIC DIMENSIONS	
Date: 17-MAR-2009 Scale: N/A	Drawing No.: 203 BOXIDIZER Revision No.: 2

ALLIANCE CORPORATION

STANDARD TERMS AND CONDITIONS OF SALE

ARTICLE 1: DEFINITIONS

1.1 The words “we”, “our” and “us” mean the Seller.

1.2 The words “you”, “your” and “yours” mean the Purchaser to whom this Proposal is made.

1.3 The word “Agreement” means the agreement under which we provide you with Goods and/or Services and includes Standard Terms and Conditions of Sale and all documents expressly incorporated by reference and all attachments.

1.4 The word “Goods” means the goods or equipment, which we will provide to you under the Agreement.

1.5 The word “Services” means installation, start-up, training, supervision, engineering, and/or services, which we will provide you under the Agreement.

ARTICLE 2: DURATION OF PROPOPSAL AND EFFECT

2.1 We may withdraw this Proposal at any time until we receive your written acceptance.

2.2 If we do not receive your written acceptance of this Proposal within 30 days of the date of the Proposal, the Proposal will expire and be void.

2.3 Any changes that you wish to make to our Proposal must be expressly accepted by us in writing, otherwise those changes will be void.

2.4 Our Material and Labor adjustment clause is incorporated by reference into this Proposal.

ARTICLE 3: SHIPMENT AND DELIVERY

3.1 Our proposed shipping schedule depends on the date which you accept our Proposal.

3.2 If you do not provide us promptly with all drawings, information, and approvals, then you will be responsible if we fail to meet our proposed shipping schedule.

3.3 We deliver the Goods F.O.B. points of shipment. This will be the only delivery that we are required to make to you. Title and risk of loss will pass to you when we make this delivery.

ARTICLE 4: TERMINATION

4.1 You may not terminate or cancel the agreement except by giving us written notice.

4.2 If you terminate or cancel, you must pay us for our costs of labor, materials, engineering, administration, and overhead incurred up to the date we receive your written notice, together with reasonable profit on these costs. These costs include any termination or cancellation charges from our vendors. If you request, we will provide you with documentation in support of these costs.

ARTICLE 5: DELAYS

5.1 We will not be in default and we will not be liable to you for loss or damage which results from delay or failure to perform any of our obligations. If this delay or failure is caused by one or more circumstances beyond our reasonable control (“Force Majeure”).

5.2 Force Majeure includes without limitations; acts of God, war act of the public enemy, civil disorder, riot, sabotage, governmental action or law or regulation, strikes or labor shortage or other labor problems, fire, flood, earthquake, severe weather, health and safety considerations, embargoes, transportation shortage or delay, fuel or material shortage, failure of performance by a vendor or subcontractor, and your failure to give timely approval and comment to documents.

5.3 The length of any delay caused by Force Majeure plus a reasonable time to resume our normal operations will extend our time of performance.

5.4 If we are ready to ship, but shipment is delayed through no fault of ours, the date on which we are ready to ship will be regarded as the date of shipment and delivery for all purposes, including payment. You will be responsible for the costs and risks of storage and handling and risk of loss commencing with that date.

ARTICLE 6: LIMITED WARRANTY

6.1 We warrant to you that the Goods will be delivered free from defects in material and workmanship.

6.2 If you discover a defect in material of workmanship during the Warranty Period (set forth below) you must give us written notice within 10 days. We will, at our option, either deliver you a replacement part, F.O.B. point of shipment and installation thereof shall be you responsibility, or repair the defect in place or elsewhere. You will provide work area, utilities, and access and egress to enable us to perform our obligation under this Section 6.2.

6.3 The Warranty Period will expire:

- A) For the purchase of original Goods, the earlier of 12 months from initial operation or 18 months from date of delivery.
- B) For the purchase of repair or replacement Goods, 12 months from date of delivery.

6.4 We will have no obligations to you under sections 6.1 and 6.2 if:

- A) You fail to operate or maintain the Goods in accordance with generally approved industry practice.
- B) You fail to operate or maintain the Goods in accordance with instructions from us.
- C) You fail to give us notice within 10 days of your discovery of a defect.
- D) The Goods or any component of the Goods have been altered, repaired or fabricated by someone other than us.
- E) Someone has installed the Goods other than us, and the installation is not in accordance with our instructions.
- F) The defect relates to corrosion, erosion, fouling and/or plugging of the Goods or to a fire or explosion relating to such corrosion, erosion, fouling and/or plugging.

6.5 We warrant to you that at delivery, the Goods will be free of any liens or encumbrances. If there are any such liens or encumbrances, we will cause them to be discharged promptly after you have notified us of their existence.

6.6 We warrant to you that the Services, if any, will be performed in a good workmanlike manner. If within the Warranty Period you discover that any portion of the services was not performed in a good workmanlike manner, you must give us notice within 10 days of your discovery and we will perform again that portion of the Services.

6.7 We make no guaranty or warranty of performance of the goods except as expressly set forth in Article 7.

6.8 THE EXPRESS WARRANTIES WE MAKE TO YOU IN THIS ARTICLE 6 AND ARTICLE 7 ARE THE ONLY WARRANTIES OR GUARANTIES WE MAKE. The are no other warranties or guaranties, whether statutory, oral, written, express, or implied. In particular, there are no implied warranties of merchantability or fitness for a particular purpose. There are no statutory, oral, implied conditions.

6.9 The remedies we provide to you in Section 6.2, 6.5 and 6.6 and Article 7 are the only remedies you will have in the event of a breach of Warranty or Performance Guarantee.

ARTICLE 7: PERFORMANCE GUARENTEE

7.1 We make the following Performance Guarantee: If all of the performance conditions are satisfied, then the Goods will reduce the concentration of hydrocarbons measured at the exhaust as compared to the concentration of the inlet to the Goods by an average of greater than 98% or down to 25 Parts Per Million (PPM) measured as C1 in the exhaust from the Goods. The performance conditions are defined in the Proposal under Design Criteria. The equipment must be operated within the design oxidization temperature of 1,600ºF. to 1,700ºF.

7.2 The only Performance Guarantee made is that which is expressly stated in section 7.1. Any other data and information pertaining to the performance of the Goods whether stated in the Agreement or elsewhere, are for purposes illustration or estimate only, and are not guaranteed.

7.3 The performance tests for determining whether the Performance Guarantee is satisfied shall be ineffective unless first reviewed and approved by us. We shall have the right and opportunity to witness the performance test. In any event, the performance tests shall consist of simultaneous measurements of hydrocarbon solvent loading at the inlet and exhaust. Methane, Ethane or other natural gas hydrocarbon contribution shall be deducted from the measurements at the exhaust. Performance test shall be at your expense, except as provided in Section 7.4. If the performance tests for any portion of the Goods are not completed before the expiration of the Warranty Period, then that portion of the Goods shall be deemed to have satisfied the Performance Guarantee, and we shall have no further obligation under the Performance Guarantee to the Goods.

7.4 If any portion of the Goods does not satisfy the Performance Guarantee as determined by the performance tests, then we shall, at our option, either:

- A) Repair, replace, or modify the goods until the Performance Guarantee is satisfied.
- B) Pay you as liquidated damages in full satisfaction of your claims arising out of the failure to meet the Performance Guarantee, an amount equal to all payments made to us for the Agreement.

C) If we elect to repair, replace or modify the Goods, then subsequent Performance Tests shall be administered at our expense (unless the Goods did not cause the failure) until the Performance Guarantee is satisfied, at which time we shall have no further obligations to the Goods under the Performance Guarantee, and if after such repair, replacement or modification the Goods fail to satisfy the Performance Guarantee, then we shall pay you liquidated damages per clause "B" above.

D) The remedies and obligations set forth in this Performance Guarantee are your exclusive remedies and our exclusive obligations in the event of the Goods failing to satisfy the Performance Guarantee.

ARTICLE 8: LIMITATION OF LIABILITY

8.1 Our liability to you under the Agreement or under any cause of action relating to the Agreement, whether based on contract, warranty, tort (including negligence), strict liability, indemnity, or otherwise will not exceed the cost of the Goods and Services.

8.2 We will not be liable to you under the Agreement or under any cause of action relating to the subject matter of the Agreement, whether based on contract, warranty, tort (including negligence), strict liability, indemnity, or otherwise for loss of profits or revenue or business opportunity, loss by reason of shutdown of your facilities or inability to operate your facilities at full capacity, cost of obtaining other means of performing the function of the Goods, claims of your customers, or incidental or consequential damages of any nature.

8.3 We will not be liable to you for any loss or damage relating to any portion or component of the Goods or Services which you sustain after the expiration of the Warranty Period pertaining to such portion or component of the Goods or Services.

8.4 You will have waived your right to sue us at law or in equity under the Agreement or under any cause of action relating the subject matter of the Agreement unless you commence your suit within one year from the date on which you sustain the loss or damage which is the subject of your suit.

8.5 The provisions of this Article 8 shall prevail over any inconsistent provisions elsewhere in the Agreement.

ARTICLE 9: PERMITS, ENVIRONMENTAL AND SAFETY RESPONSIBILITIES

9.1 You will (at your expense) obtain and maintain in force all permits and approvals necessary for the installation and operation of the Goods and the performance of the Services, and disposal of waste products.

9.2 If you fail to perform your obligations under Section 9.1, or if you fail to do the following:

A) Operate Goods in compliance all applicable laws, rules, regulations, permits and approvals, and with operating instructions (including safety related instructions) which we issue from time to time.

B) Dispose of any waste products in compliance will all applicable laws, rules, regulations, permits and approvals.

C) In operating the Goods and disposing of the waste products, avoid contributing to air or water pollution or any conditions which is hazardous to health; then you will indemnify us and hold us harmless and defend us at your expense from any claim, suit, liability, or penalty which may result from such failure.

ARTICLE 10: TAXES

10.1 You will pay all sales, use, value added, excise, and other taxes, which may be levied or assessed on the transfer of the Goods to you, or on the performance of Services or on the Agreement, or on our performance under this Agreement. Unless specifically stated otherwise in the Proposal, our price to you does not include any such taxes.

Article 11: Patents

11.1 We will defend you against any suit, which claims that the goods infringe any United States patent. We will satisfy any judgement for damages entered against you in such suit. If such judgement enjoins you from using the Goods, then we shall at our option:

A) Obtain for you the right to continue using the Goods.

B) Eliminate the infringement by replacing or modifying all or part of the Goods.

C) Take back the Goods and refund to you all payments that we have received for the Goods. In this event, neither you, nor we will have any claim against the other under the Agreement or arising out of the subject matter of the Agreement.

11.2 We will have no obligation under this Article 11 if you fail to notify us promptly of any claim or suit for infringement or if you fail to cooperate with us in conducting the defense, or if infringement results from:

A) Use of Goods except in accordance with our instructions to you.

B) Any change made to the Goods after we make delivery.

C) Any portion of the Goods made pursuant to your design.

11.3 The remedies that we provide to you in this Article 11 are the only remedies you will have in the event of any infringement claim.

ARTICLE 12: CHANGES

12.1 We will not make changes in the Goods or Services unless you and we have executed a written Change Order for such change.

12.2 The Change Order will include a price adjustment for any added costs of the change plus a reasonable profit.

12.3 If the change impairs our ability to satisfy our obligations to you, including meeting, delivery schedules and any Performance Guarantee, the Change Order will include appropriate modifications to the Agreement.

12.4 If after the earlier of either:

A) The date of the Proposal on which the Agreement is based.

B) The date of the Agreement, new or revised governmental or code requirements shall require a change in the Goods, the change will be the subject of a Change Order pursuant to this Article 12.

ARTICLE 13: CONFIDENTIALITY – USE OF DRAWINGS

13.1 You acknowledge that the information that we submit to you in connection with this Proposal for the Agreement includes our confidential and proprietary information, both of a technical and commercial nature.

13.2 You will not disclose our confidential and proprietary information to third parties without our prior written consent.

13.3 You will not permit any third party to fabricate components of the Goods from our drawings. You will indemnify us and hold us harmless and defend us from any claim, suit, or liability based on personal injury (including death) or property damage related to any component of the Goods which is fabricated by a third party without our prior written consent.

13.4 The Goods may contain software and related instructions and other material, which we have provided. Your use thereof shall be subject to license conditions and other restrictions, which we or our suppliers or may impose to maintain confidentiality.

ARTICLE 14: EQUAL EMPLOYMENT OPPORTUNITY COMPLIANCE

14.1 We shall at all times comply with the requirements of the Executive Order 11246.

ARTICLE 15: END USER

15.1 If you are not the End User of the Goods or Services, then you will use you best efforts to obtain the End User's consent to be bound to us by the provisions of the Agreement.

15.2 If you do not obtain such End User consent, than you shall indemnify us and our agents, employees, subcontractors and suppliers from any liability, cost, loss, or expense for which we would not have been liable or from which we would have been indemnified if you had obtained the End User consent.

ARTICLE 16: ENTIRE AGREEMENT

16.1 The Agreement contains the entire understanding between you and us, and supercedes any prior oral or written understandings between you and us concerning the Goods and Services including any document, which is not expressly incorporated by reference into this Agreement.

16.2 No modifications to the Agreement will be effective unless in writing duly executed by you and us.

16.3 The Agreement is binding on the parties and their respective successors and assignees.

ARTICLE 17: INVALIDITY

17.1 If a final decision of a court of competent jurisdiction holds invalid a portion of any sentence of this Agreement, or a sentence of any Section of the Agreement or a Section of any Article, or any Article of this Agreement, the remainder of such effected sentence or Section or Article of this Agreement shall remain valid.

ARTICLE 18 GOVERNING LAW

18.1 The agreement will be governed by and construed according to the laws of the State of California.